

REMARKS

Claims 5-7, 15-19, 23, 29-31 and 35-46 are pending, with claims 5, 6, 15, 16, 35, 36, 39, and 40 being independent. Claims 1-4, 8-14, 20-22, 24-28, and 32-34 have been canceled. Claims 5, 6, 16-18, 29, and 30 have been amended, and claims 35-46 have been added.

Independent claims 6, 15, and 16 have been rejected as failing to comply with the written description requirement for lacking support for the limitation "a concentration of the germanium (said element) is within a range of 0.1 atom% to 10 atom%" Applicants respectfully refer the Examiner to page 123, line 23 to page 124, line 1 of the application specification wherein support for this claim limitation is disclosed: "a first amorphous semiconductor film which contains silicon as its main component and germanium the content of which is *0.1 atomic % or more and 10 atomic % or less*, and a second amorphous semiconductor film which contains silicon as its main component are stacked" (emphasis added). Accordingly, applicants respectfully request reconsideration and withdrawal of this rejection.

Independent claims 5 and 6, and dependent claims 7 and 23, have been rejected as being unpatentable over Shimizu (U.S. Patent No. 5,753,541) in view of Noguchi (JP 04-168769). Each of claims 5 and 6, as amended, recites a method of manufacturing a semiconductor device including the steps of forming a first amorphous semiconductor film comprising silicon and germanium on an insulating surface, forming a second amorphous semiconductor film on and in contact with the first amorphous semiconductor film, and crystallizing each of the amorphous semiconductor films by irradiating with an *excimer laser light*. Applicants request reconsideration and withdrawal of the rejection of claims 5 and 6, and their dependent claims, because neither Shimizu, Noguchi, nor any combination of the two describes or suggests the recited method of manufacturing a multi-layer device using an excimer laser.

Shimizu describes a method of fabricating a thin field effect transistor on a glass substrate 1 including the steps of forming a silicon nitride layer 1a on the glass substrate, an amorphous silicon layer 5a on the silicon nitride layer 1a, and an amorphous germanium layer 6a on the amorphous silicon layer 5a (Fig. 1, col. 5, lines 18-32). Shimizu suffers from two deficiencies with respect to claim 5 and 6. First, the amorphous germanium layer 6a, which the Examiner

equates to the recited first amorphous semiconductor film, does not include silicon and, accordingly, is not a "silicon and germanium" film as claimed. Second, the step of forming the amorphous germanium layer 6a occurs after the step of forming the amorphous silicon layer 5a, which the Examiner equates to the recited second amorphous semiconductor film. Accordingly, Shimizu also fails to describe or suggest forming a second amorphous semiconductor film on and in contact with the first amorphous silicon and germanium semiconductor film.

The Examiner relies upon Noguchi to cure the deficiency of Shimizu with respect to Shimizu's lack of a "silicon and germanium" film. The Examiner also attempts to cure the deficiency of Shimizu with respect to the order of the manufacturing process steps by asserting that "selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results."

The order of performing the processing steps in claims 5 and 6, however, does provide new and unexpected results when using a laser for crystallization. In particular, the specification teaches at page 21, line 25 to page 22, line 25 that, when a semiconductor film is subjected to a laser treatment, the semiconductor film receives the undesirable influence of an undercoat insulating film (SiO_2); however, when the semiconductor film has a stacked layer made of a germanium-containing silicon film and a silicon film, the silicon film changes a phase to the solid phase without receiving the undesirable influence of the undercoat insulating film (SiO_2) because the germanium-containing silicon remains in a molten liquid phase. The undesirable influence of an undercoat insulating film (SiO_2) on the crystallization of the silicon film is explained in Sasaki, a non-prior art reference document submitted with this response. Sasaki describes that, when a laser is used to perform crystallization of a silicon layer over an undercoat insulating film (SiO_2), the crystal growth is "unsteady" because the "silicon crystals grow from the random crystal nuclei generated at the Si- SiO_2 interface." In view of this teaching, changing the order of the layers such that the Si-Ge layer exists at the interface with the insulating layer, rather than the Si layer, results in unexpected superior crystal growth because the Si-Ge layer has a superior crystal orientation and functions as a much better seed than the underlying insulating film.

For the above reasons, Shimizu, which discloses an amorphous silicon layer 5a in contact with an underlying insulating film 1a, would enjoy non-obvious and unexpected benefits through a change in the order of its processing steps such that the amorphous silicon layer 5a is in contact with a silicon and germanium layer, rather than with an underlying insulating film. Accordingly, claims 5 and 6 are not obvious variations of Shimizu, Noguchi, or any combination of the two, and, therefore, applicants respectfully request reconsideration and withdrawal of the rejection of claims 5 and 6, and their dependent claims 7 and 23.

Independent claims 15 and 16, and dependent claims 17 and 29, have been rejected as being unpatentable over Shimizu in view of Noguchi and Teramoto (U.S. Patent No. 5,923,966).

Claim 15 recites a method of manufacturing a semiconductor device including the steps of forming a first amorphous semiconductor film comprising silicon and germanium on an insulating surface, forming a second amorphous semiconductor film on and in contact with the first amorphous semiconductor film, introducing an element capable of promoting crystallization into the first or second amorphous semiconductor films, and crystallizing each of the amorphous semiconductor films by heating. Applicants request reconsideration and withdrawal of the rejection of claims 15 and 17, because neither Shimizu, Noguchi, Teramoto, nor any proper combination of the three describes or suggests the recited method of manufacturing a multi-layer semiconductor device wherein an element capable of promoting crystallization is introduced into a stacked layer made of a germanium containing silicon film and a silicon film.

Neither Shimizu nor Noguchi describes or suggests a manufacturing method in which an element capable of promoting crystallization is used. Teramoto teaches the introduction of a metal element into an amorphous silicon layer to promote crystallization. Teramoto at col.2, lines 41-55. Nothing in Teramoto, Shimizu, or Noguchi, however, would have led one of ordinary skill to introduce a metal element to into a multi-layer structure such as that described by Shimizu and Noguchi. This is particularly true considering that Shimizu and Noguchi already indicate that the use of germanium in the multi-layer structure already promotes crystallization. See Shimizu at col. 3, line 64 to col. 4, line 30; and Noguchi at abstract. For at least these

reasons, applicants request consideration and withdrawal of the rejection of claim 15 and its dependent claim 17.

Claim 16 recites a method of manufacturing a semiconductor device that includes all of the steps recited in claim 15 with the exception that claim 16 recites forming a first amorphous semiconductor film that includes silicon and an element having a larger atomic radius than silicon while claim 15 recites forming a first amorphous semiconductor film that includes silicon and germanium. For at least the same reasons described previously with respect to claim 15, applicants request reconsideration and withdrawal of the rejection of claim 16 and its dependent claim 29.

Claims 18 and 30, which depend from claims 15 and 16, respectively, have been rejected as being unpatentable over Shimizu in view of Noguchi, Teramoto, and Maekawa (U.S. Patent No. 6,066,547). Maekawa does not remedy the failure of Shimizu, Noguchi, and Teramoto to describe or suggest the subject matter of claims 15 and 16.. Accordingly, applicants request reconsideration and withdrawal of the rejection of claims 18 and 30.

Claims 19 and 31, which depend from claims 15 and 16, respectively, have been rejected as being unpatentable over Shimizu in view of Noguchi, Teramoto, and Zhang (U.S. Patent No. 5,578,520). Zhang does not remedy the failure of Shimizu, Noguchi, and Teramoto to describe or suggest the subject matter of claims 15 and 16. Accordingly, applicants request reconsideration and withdrawal of the rejection of claims 19 and 31.

Independent claims 5, 6, 15, and 16, and dependent claims 7, 19, and 31 have been rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over independent claims 1, 50, and 59, and dependent claims 7, 51, 60, and 66, of Yamazaki (U.S. Patent No. 6,482,684).

As described previously, claims 5 and 6 recite a method of manufacturing a multi-layer device that includes forming a stacked layer made from an amorphous silicon film on an amorphous germanium containing silicon film and crystallizing the stacked layer by irradiating with an excimer laser light. Independent claims 1, 50, and 59, and dependent claims 7, 51, 60,

and 66, of Yamazaki do not describe or suggest forming the recited stacked layer and crystallizing the stacked layer using an excimer laser.

Independent claims 1, 50, and 59 of Yamazaki recite forming an amorphous semiconductor film and forming a film including germanium in contact with the amorphous semiconductor film. The Examiner contends that it would have been obvious to change the order of these two steps to form the recited stacked layer of claims 5 and 6 because the "selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results." However, for the reasons described previously with respect to claims 5 and 6, the order of performing the processing steps in claims 5 and 6 does provide new and unexpected results when using a laser for crystallization.

For at least these reasons, applicants request reconsideration and withdrawal of the double-patenting rejection of claims 5 and 6, and dependent claim 7, which depends from claim 6.

As described previously, claim 15 recites a method of manufacturing a multi-layer semiconductor device wherein an element capable of promoting crystallization is introduced into a stacked layer made of a germanium containing silicon film and a silicon film. Claims 1, 50, and 59, and dependent claims 7, 51, 60, and 66, of Yamazaki do not describe or suggest the recited step of introducing an element to promote crystallization into a stacked layer. In fact, the claims are entirely silent as to the use of crystallization promoting elements, much less the use of such elements in the recited stacked layer. Accordingly, applicants request reconsideration and withdrawal of the double-patenting rejection of claim 15, and its dependent claim 19.

Claim 16 recites a method of manufacturing a semiconductor device that includes all of the steps recited in claim 15 with the exception that claim 16 recites forming a first amorphous semiconductor film that includes silicon and an element having a larger atomic radius than silicon while claim 15 recites forming a first amorphous semiconductor film that includes silicon and germanium. For at least the same reasons described previously with respect to claim 15, applicants request reconsideration and withdrawal of the double patenting rejection of claim 16 and its dependent claim 31.

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Page : 15 of 15

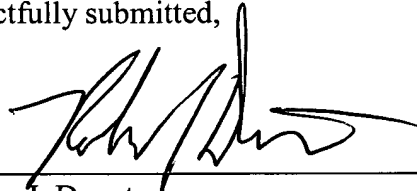
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New claims 35-46, including independent claims 35, 36, 39, and 40, describe methods of manufacturing a semiconductor device that includes forming an amorphous silicon and germanium layer, forming an amorphous semiconductor film on and in contact with the amorphous silicon and germanium layer, and crystallizing the two amorphous layers by irradiating with a laser light or excimer laser light. Claims 35-46 are patentable over the cited art for at least the same reasons described above with respect to independent claims 5 and 6.

Applicants submit that all claims are in condition for allowance.

Enclosed is a \$980 check for the Petition for Extension of Time fee. Please apply any other charges or credits to deposit account 06-1050.

Respectfully submitted,



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